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Science Response 2012/041

PROBABILITY OF SPOT PRAWN (*PANDALUS PLATYCEROS*) STOCKS IN FALL SURVEY AREAS IN BRITISH COLUMBIA BEING BELOW SPAWNER INDEX REFERENCE POINTS DURING THE SPAWNING PERIOD

Context

Since 2001, fishery independent sampling of Spot Prawn (*Pandalus platyceros*, hereafter referred to as "prawn") stocks in selected areas along the coast of British Columbia has been conducted annually by Fisheries and Oceans Canada (DFO) in the fall, prior to spawning season. This sampling occurs in waters neighbouring urban populated areas where commercial, recreational, and First Nation prawn harvest takes place. For this report, these areas are referred to as "fall survey areas".

Harvest of prawns by the commercial fishery is monitored in-season through an industry-funded program that collects spawner index (SI) data. Commercial closures are triggered using escapement based SI reference points. The commercial fishery opens in early May and closes once the SI reference point is reached, typically late June or early July. Normally, for most areas along the coast the recreational fishery for prawns occurs year-round. The exception to this is in the fall survey areas where fall fishery-independent sampling provides the SI data necessary for DFO Fisheries Management (FM) to manage the recreational fishery. If the SI threshold falls below the pre-determined reference point the area is closed to recreational fishing for a 3 month period during the prawn spawning period (January to March).

Continuation of the DFO fall fishery-independent sampling program for 2012 and beyond is uncertain. While DFO continues to seek options to continue fall sampling, FM has requested a review of the 2001 to 2011 sampling results in relation to SI reference points in the fall survey areas. In the absence of fall SI sampling, there could be negative impacts to prawn stocks if directed harvest continues and stocks breach SI thresholds. Due to the likelihood of no fall sampling and the short timeframe for the finalization of the Integrated Fisheries Management Plan (IFMP), a Science Response was requested by FM to provide specific advice on:

1) The probability of prawn stocks being below spawner index reference points during the spawning period, based on the past fall sampling results; and,
2) Identifying any area differences in probability by fall survey area groupings and by Pacific Fishery Management Area (PFMA) sub-area groupings.

This report provides probability estimates, based on the 2001 to 2011 fall sampling, of prawn stocks being below SI reference points in the fall survey areas.

This Science Response is from the March 15, 2012 meeting on the Probability of Spot Prawn (*Pandalus Platycerso*) Stocks in High-Use Areas in British Columbia being below Spawner Index Reference Points during the Spawning Period to review the results of the fall fishery-independent prawn sampling program in relation to SI reference points.

Canada

Background

Various SI reference points are used in the management of prawn fisheries to control harvest and these include:

1) a "base" SI reference point which is a *de facto* Limit Reference Point (LRP);
2) a "110" SI reference point (base + 10%); and,
3) "FM" SI reference points that are unique to various areas.

For this report, we estimated the probability of prawn stocks being below each of the three SI reference points described above. A provisional LRP was proposed in DFO (2009); however, this LRP has not been evaluated, is not currently implemented and is below the historically used "base" reference point (*de facto* LRP); therefore, it is not included as a reference point in this document. Further information on formulation of the SI and reference points is available in Boutillier and Bond (2001), DFO (2009) and DFO (2011).

Monitoring of prawn stocks is carried out on a Pacific Fishery Management Area (PFMA) sub-area spatial scale. The sub-areas sampled by the fall surveys are also grouped into fall survey areas. The names of the fall survey areas and their corresponding PFMA sub-areas are:

- Saanich Inlet (19-7 to 19-12)
- Stuart Channel (17-5, 17-6, 17-9)
- Alberni Inlet (23-1 to 23-3)
- Quadra/Cortes Islands (13-1, 13-12 to 13-17)
- Powell River (15-1 to 15-3)
- Salmon/Sechelt Inlets (16-5 to 16-8)
- Madeira Park/Lower Jervis (16-1,16-2,16-9 to 16-11, 16-16 to 16-18)
- North Nanaimo (17-10 to 17-13, 17-15, 17-16, 17-18)
- Barkley Sound (23-4)
- Tahsis/Muchalat Inlets (25-1 to 25-5, 25-8 and 25-16)
- Howe Sound (28-1 to 28-5)

Analysis and Responses

Data collected in fall sampling programs from 2001-2011 were used to estimate the probability of prawn stocks being below the various SI reference points in future years. Predicting the probability of occurrences in future years was addressed by analyzing the historical data (2001-2011) and assuming past results in relation to SI reference points will be predictive of what to expect in the future.

For this analysis, the 2001-2011 data were rolled up in three different ways to address the questions posed by FM: First, every sub-area SI estimate, calculated over the 11 years, was used to estimate an overall probability of stocks being below the various reference points, Secondly, sub-area SI estimates, calculated over the 11 years, were grouped into the 11 fall survey areas to address the area difference question. Lastly, sub-area SI samples were grouped by sub-area, across all years, to address the sub-area difference question.

A total of 403 PFMA sub-area SI estimates were obtained between 2001 and 2011. Of the 403 estimates, 32%, 36% and 38% were below the base, 110 and FM reference points respectively (Table 1).

When grouped by the 11 fall survey areas, the percentage of estimates: (1) below the base SI reference point ranged from 14% to 69%; (2) below the 110 SI reference point ranged from 14% to 75%; (3) below the FM SI reference point ranged from 21% to 73%. At all three SI reference points, Salmon/Sechelt Inlets and Barkley Sound groupings had the lowest percentages; the Madeira Park/Jervis grouping had the highest (Table 1).

Table 1. Percentage of sub-area SI estimates, by fall survey area, below the three SI reference points.

		Percent Below SI Reference Point		
Grouping	N	Base	110	FM
All sub-areas	403	32%	36%	38%
Saanich Inlet	32	44%	50%	63%
Stuart Channel	29	41%	48%	55%
Alberni Inlet	33	36%	48%	52%
Quadra/Cortes Islands	71	15%	21%	21%
Powell River	20	50%	50%	50%
Salmon/Sechelt Inlets	29	14%	14%	14%
Madeira Park/Lower Jervis	51	69%	75%	73%
North Nanaimo	46	22%	24%	24%
Barkley Sound	7	14%	14%	14%
Tahsis/Muchalat Inlets	30	20%	27%	27%
Howe Sound	55	27%	29%	27%

When grouped by sub-area across all years (and removing subareas with sample size's less than two) five sub-areas never fell below the base SI reference point, these were 13-13, 16-6, 25-2, 25-8, 28-2. Of these five, only 25-2 fell below the 110 and FM reference points. Two sub-areas, 16-1 and 16-18 fell below all three reference points in every year sampled (Appendix 1).

Conclusions

Based on past sampling and results, the probability of prawn stocks in the fall survey areas being below the base, 110 and FM SI reference points is 32%, 36% and 38% respectively. There are area differences in the probabilities of being below the SI reference points, with some fall survey areas having a lower probability than others. The fall survey areas with the lowest probability of being below reference points were Salmon/Sechelt Inlets and Barkley Sound; however, there was still a 14% probability of being below the base reference point. There are sub-area differences in probability of falling below reference points, however, sample size decreased with partitioning into smaller areas, so there is less reliability in the estimated probabilities at the sub-area level.

To predict future probabilities, of prawn stocks being below the SI index, based on past sampling, is contingent on the assumption that what has occurred from 2001 to 2011 will remain unchanged and continue into the future. This is a tenuous assumption, since factors such as environmental conditions, prawn removals and SI values prior to fall surveys were not assessed as to their level of influence on the predictive value of the results presented.

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Sources of information

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Appendices

Appendix 1. Percentage of SI estimates, by sub-area, below SI reference points, 2001 to 2011.

Sub-area	Fall Survey Area	N	Percent Below SI Reference Point		
			Base	110	FAM
13-1	Quadra/Cortez Islands	8	13%	13%	13%
13-12	Quadra/Cortez Islands	11	18%	36%	36%
13-13	Quadra/Cortez Islands	11	0%	0%	0%
13-14	Quadra/Cortez Islands	10	10%	10%	10%
13-15	Quadra/Cortez Islands	10	30%	30%	30%
13-16	Quadra/Cortez Islands	11	27%	36%	36%
13-17	Quadra/Cortez Islands	10	10%	20%	20%
15-1	Powell River	7	29%	29%	29%
15-2	Powell River	7	71%	71%	71%
15-3	Powell River	6	50%	50%	50%
16-1	Madeira Park/Lower Jervis	6	100%	100%	100%
16-2	Madeira Park/Lower Jervis	8	63%	63%	63%
16-5	Salmon/Sechelt Inlets	5	20%	20%	20%
16-6	Salmon/Sechelt Inlets	11	0%	0%	0%
16-7	Salmon/Sechelt Inlets	10	20%	20%	20%
16-8	Salmon/Sechelt Inlets	3	33%	33%	33%
16-9	Madeira Park/Lower Jervis	3	33%	33%	33%
16-10	Madeira Park/Lower Jervis	10	70%	80%	70%
16-11	Madeira Park/Lower Jervis	4	25%	25%	25%
16-16	Madeira Park/Lower Jervis	3	33%	67%	67%
16-17	Madeira Park/Lower Jervis	9	67%	78%	78%
16-18	Madeira Park/Lower Jervis	8	100%	100%	100%
17-5	Stuart Channel	9	44%	44%	56%
17-6	Stuart Channel	11	27%	27%	36%
17-9	Stuart Channel	11	45%	64%	73%
17-10	North Nanaimo	6	17%	17%	17%
17-11	North Nanaimo	7	14%	14%	14%
17-12	North Nanaimo	9	22%	22%	22%
17-13	North Nanaimo	9	11%	22%	22%
17-15	North Nanaimo	4	25%	25%	25%
17-16	North Nanaimo	7	43%	43%	43%
17-18	North Nanaimo	4	25%	25%	25%
19-7	Saanich Inlet	11	18%	27%	36%
19-8	Saanich Inlet	11	64%	73%	82%
19-10	Saanich Inlet	5	60%	60%	80%
19-11	Saanich Inlet	3	67%	67%	67%
23-1	Alberni Inlet	11	64%	64%	73%
23-2	Alberni Inlet	11	27%	36%	36%
23-3	Alberni Inlet	11	18%	36%	45%
23-4	Barkley Sound	7	14%	14%	14%
25-1	Tahsis/Muchalat Inlets	5	20%	40%	40%
25-2	Tahsis/Muchalat Inlets	5	0%	20%	20%
25-3	Tahsis/Muchalat Inlets	4	25%	25%	25%
25-4	Tahsis/Muchalat Inlets	5	20%	20%	20%
25-5	Tahsis/Muchalat Inlets	4	25%	25%	25%
25-8	Tahsis/Muchalat Inlets	5	0%	0%	0%
25-16	Tahsis/Muchalat Inlets	2	50%	50%	50%
28-1	Howe Sound	11	36%	36%	36%
28-2	Howe Sound	11	0%	0%	0%
28-3	Howe Sound	11	9%	9%	9%
28-4	Howe Sound	11	18%	18%	18%
28-5	Howe Sound	11	73%	82%	73%

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